

1923. It is our hope that all organizations and agencies, civic, political and otherwise, that are in any manner concerned in the conservation of life and limb and whose aid is so essential in the success of this movement will unite in a common enterprise and that as a result our co-operation will become more extensive, so that it will assume a force of such magnitude and power as will serve to wipe out this needless slaughter of human life.

## SURVEYS AND PLANS FOR COUNTY ROADS

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By W. W. Southard,  
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There has been a great improvement during the last ten years in the method of making road surveys and in the care taken in the preparation of plans for road improvements. Formerly it was almost universal custom for surveyors to run levels down the center of the proposed road and merely plat a profile showing the difference in elevation at one hundred foot stations. A new grade line was shown which gave the cuts and fills in the center of the road but there was no way to determine the amount of earth to be excavated at the sides. Consequently the surveyor's estimate was a guess, and similarly the contract in making his bid could only approximate the amount of earth to be moved.

The entrance of the State Highway Commission into the field of road construction has given the surveyors of the state an example to follow in the method of making surveys and the preparation of plans. The Bureau of Public Roads of the U. S. Department of Agriculture has laid down very exact and definite requirements which must be met by all states on Federal Aid Roads. In turn the Indiana Highway Commission has made rulings covering the plans to be submitted to them by the counties when asking state approval of plans and specifications. This, together with the desire of most surveyors to prepare plans as nearly approaching the perfection of those of the State Highway Commission as practical, has resulted in the improvement mentioned above.

I will try to outline briefly the methods to be followed in surveys of the different types of roads in this state.

In the central and northern part of the state most of the roads follow section or half-section lines. In the southern part

of the state, on account of the rough and hilly nature of the topography, it was necessary in most cases to locate the early roads to follow the water courses and wind around the hills, "meandering" roads I will call them.

In the re-survey of roads of the first type mentioned the section and half-section corners should first be located. In case any of these have been removed the surveyor should make a re-survey of the section and set the corner, as it is essential that the permanent improvement should be correctly located so that our successors will not make wrong assumptions on land surveys. These section and half-section corners should be referenced so that if taken out during grading and construction, permanent markers can be set in the surface of the finished road.

After the corners are located the center line of the road should be run with an engineer's transit and each station marked, either by means of an offset stake set along the side of the road at some definite offset, or by means of marks in the center of the road. I prefer the latter method and use for this purpose a two-inch oval head spear point hinge nail with a small piece of red calico two inches square. We find that these center line markers will stay for a sufficient length of time to permit us to get about two or three miles of center line located, then come back and run levels over the points.

In running levels it is always desirable to use sea level datum. If you have no elevations based on this datum such can usually be secured by writing to the division engineer of any railroad running through the locality. Where sea level datum cannot be secured it is permissible to assume a starting elevation. The elevation should be secured at all center line points and abrupt breaks in ground level, with elevation of sufficient points on each side of the center line to give an accurate cross-section of the road at that point. The flow line or channel elevation at all pipe culverts and other structures should be secured, also the floor of bridges and slab culverts and the top of the crown on all arch structures.

It is well also to ascertain the condition of all culverts and structures and note same in the field book. Look through pipes and see if they are functioning properly or if they are worth leaving in place and make recommendation on each. Sketch all structures and supply all important dimensions so that plans can be prepared for widening or repairing if the condition warrants.

Bench marks should be set at intervals not greater than one-fourth mile and upon completion of the profile check levels should be run back over these benches. This will locate errors in rod readings or computations during the survey and save

trouble when construction is begun. You will find it of great assistance later if you make recommendations in the field book regarding the amount of cutting or filling advisable at various points and also concerning drainage features that may be noticed during the survey.

On the winding or meandering roads the procedure is as outlined above, except that the location of center line is not limited. These old roads have been located on vague descriptions which in most cases are impossible to relocate and the surveyor is at liberty to pick his new location to fit modern requirements. He can vary from the original road where desirable to make a better location and should exercise his judgment in such matters as the survey proceeds. The new center line should be tied into the nearest section or half-section corner and the angle between the center line and section lines read. Reference in all deflection points, measure the external or distance from point of intersection of tangents to the location desired for center line on curves, and from the table of "Functions of a One-degree Curve" in the Engineer's Hand Book ascertain the degree of curve and the tangent lengths. The curve can then be run in and cross-sections taken from points on the new center line.

In preparing the report of viewers and engineer a corrected description should be used so that the road as relocated can be put on future maps and plat books.

In drafting the plans it is advisable to use the plan and profile sheets recommended by the Bureau of Public Roads, either Plate I or Plate II. The contractor for county printing can secure these for you and if paper is used the cost is not high. The plan should show all physical features on the existing road, such as fence lines, pole lines, railroad or inter-urban tracks, buildings near enough to the road to be affected by the improvement, and all structures encountered during the survey.

The profile should be plotted at a scale of 100 feet to the inch horizontal and 10 feet to the inch vertical, the grade line laid and vertical curves supplied at all pronounced changes in grade. Station numbers, elevations on profile and elevations on new grade with the amount of cut or fill should be shown below the profile.

The cross-sections should be platted on cross-section paper or on Plate II of the Bureau of Public Roads standard with a scale of five feet to the inch. The area of cut and of fill should be measured separately, preferably by use of a planimeter, and entered on the sheet at the section measured. These areas should also be entered on a tabulation sheet, the areas of adjoining sections averaged and the volume of earth work

computed. The plans department of the State Highway Commission has a table of earthwork volumes which is valuable in that it saves much labor in computing these volumes.

With the amount of earthwork determined you will know whether it is desirable to leave the grade line as located or to raise or lower same for more economical construction. After the earthwork quantities are finally determined they should be entered on the profile between balance points and the engineer is ready to prepare his cost estimate and write the specifications.

It will be readily understood that in a paper of this sort no attempt can be made to go far into the details of surveys, preparation of plans or specifications. I have endeavored merely to sketch an outline of the procedure in the field and office. Each surveyor will have to work out his own details in accordance with local conditions and the type of improvement. Too much care cannot be taken, however, in any of the steps and the carefulness and accuracy of the surveyor will be reflected in the completeness and therefore usefulness of the plans as prepared. The cost estimate should be carefully prepared so that it will be useful to guide the contractor in preparing his proposal. Good plans and sensible estimates attract reputable contractors and result in satisfactory workmanship, thereby giving the public a proper return for the investment.

### TEST ROAD IN ST. JOSEPH COUNTY

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By A. C. Mangus,  
St. Joseph County Highway Superintendent.

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No highway improvement can be considered as permanent—forever enduring. The period of useful life of any highway improvement is limited. The time will come when the pavement must be reconstructed. This period of useful life may be longer, under like conditions, with one type of construction than with another. In any case the period of useful life is lengthened by careful attention to the maintenance of the improvement. By proper maintenance the day of reconstruction may be delayed and the period of useful life lengthened, permitting us to have the use of the pavement at a lesser cost per year by distributing the first cost over a greater number of years. However, the time will come when the